Sheet 1

20) $N_1 = 50$, $N_2 = 10$, $V_1 = 440V$, $f = 50Hz$, $S = 10KVA$

a) $V_2 = V_1 \frac{N_2}{N_1} = 440 \times \frac{10}{50} = 88V$

b) $S = V_1 I_1 = V_2 I_2$

$\therefore I_1 = \frac{S}{V_1} = \frac{10K}{440} = 22,72\ A$

$I_2 = \frac{S}{V_2} = \frac{10K}{88} = 113,63\ A$

c) $\Phi_m = \frac{E_1}{4.44 N_1 f} = \frac{440}{4.44 \times 50 \times 50} = 0.0396\ Wb$

21) $N_1 = 350$, $N_2 = 1050$, $V_1 = 400V$, $f = 50Hz$, $A = 50\ cm^2$

i) $B_{max} = \frac{E_1}{4.44 N_1 f A} = \frac{400}{4.44 \times 350 \times 50 \times 50 \times 10^{-4}} = 1.03\ Wb/m^2$

22) $I\phi = 10A$, $P_f = 0.25$ lag, $V_1 = 400V$, $f = 50Hz$

a) $\theta = -\cos^{-1}(0.25) = -75,52$

$I_c = I\phi \cos\theta = 2,5\ A$

$I_m = I\phi \sin\theta = 9,68A$

b)

c) $N_1 = 500 \longrightarrow \Phi_{max} = \frac{V_1}{4.44 N_1 f k} = \frac{400}{4.44 \times 500 \times 50} = 3,6 \times 10^{-3}$

23) $S = 15\,KVA$, $V_1 : V_2 = 2200 : 110\,V$, $R_1 = 4,75\,\Omega$, $R_2 = 0.0045\,\Omega$
$X_1 = 2,6\,\Omega$, $X_2 = 0,0075\,\Omega$

a) $Req_1 = R_1 + \bar{R}_2 = R_1 + a^2 R_2 = 4,75 + \left(\frac{2200}{110}\right)^2 * 0.0045$
$= 6,55\,\Omega$

b) $Req_2 = \bar{R}_1 + R_2 = \frac{R_1}{a^2} + R_2 = 4,75\left(\frac{110}{2200}\right)^2 + 0.0045$
$= 0.0163\,\Omega$

c) $Xeq_1 = X_1 + \bar{X}_2 = X_1 + a^2 X_2 = 2,6 + \left(\frac{2200}{110}\right)^2 * 0.0075$
$= 5,6\,\Omega$

d) $Xeq_2 = \bar{X}_1 + X_2 = \frac{X_1}{a^2} + X_2 = \frac{2,6}{}\left(\frac{110}{2200}\right)^2 + 0.0075$
$= 0.014\,\Omega$

e) $Zeq_1 = Req_1 + j\,Xeq_1 = 6.55 + j\,5.6$

f) $Zeq_2 = Req_2 + j\,Xeq_2 = 0.0163 + j\,0.014$

* g)

*24) $V_1 : V_2 = 250 : 225$, $S = 5\,KVA$, $R_1 = 0.2\,\Omega$, $X_1 = 0.75\,\Omega$
$R_2 = 0.05\,\Omega$, $X_2 = 0.2\,\Omega$.

25) $S = 5KVA$, $V_1 : V_2 = 500 : 250$, $f = 50\ Hz$

	V	I	P
o.c	500	1	50
s.c	25	10	60

o.c (L.V open) ⟶ ref to High
s.c (L.V short) ⟶ ref to High

a) $\eta = \dfrac{n\,(V.A)_{f1}\cos\theta}{n(V.A)_{f1}\cos\theta + P_o + n^2(P_{cu})_{f1}} * 100$

P.F = 0.8 Lag

$n = \frac{100}{100}$ full load $(V.A)_{f1} = S = 5KVA$

$P_c = P_{o.c} = 50\ w$, $P_{cu} = P_{s.c} = 60w$

$$\eta = \frac{5000 * 0.8}{5000*0.8 + 50 + 60} * 100 = 97,3\ \%$$

b) $$V.R = \frac{V_s(\text{no Load}) - V_s(\text{full load})}{V_s(\text{full load})} * 100$$

$V_{s(FL)} = V_2 = 250V$

$V_s(\text{no load}) = V_p$

$V_p = I_s Z_{eq} + V_s$

$I_s = I_{s.c} \angle \cos^{-1}(0.8) = 10 \angle -36,86$

Z_{eq} (From Short Circuit test in(d)=)

then $V_p = 10\angle -36,86 * 2.5 + 250 = 270 \angle -3,17$

then $V.R = \dfrac{270 - 250}{250} * 100 = 8\ \%$

c) From (a) then, at 60% full

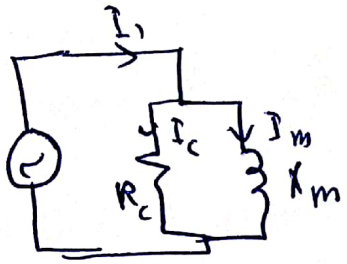
$$\eta = \frac{\frac{60}{100} * 500 * 0.8}{\frac{60}{100} * 500 * 0.8 + 50 + (\frac{60}{100})^2 * 60} * 100 = 97.1\ \%$$

d) * First O.C test

$\therefore P_{o.c} = V_{o.c} I_{o.c} \cos\theta$

$\therefore \theta = \cos^{-1}\left(\frac{P_{o.c}}{V_{o.c} I_{o.c}}\right) = \left(\frac{50}{500 \times 1}\right) V_1$

$= 84,26$



$I_c = I_{o.c} \cos\theta = 1 \cos(84,26) = 0.1\ A$

$I_m = I_{o.c} \sin\theta = 0,994\ A$

$R_c = \frac{V_{o.c}}{I_c} = 5000\ \Omega$, $X_m = \frac{V_{o.c}}{I_m} = 503\ \Omega$ } Ref to High (Primary)

* Second S.C test

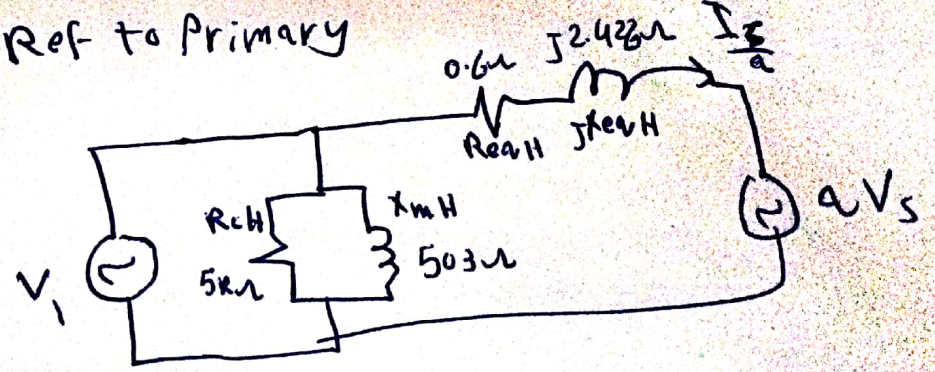
$\theta = \cos^{-1}\left(\frac{P_{s.c}}{V_{s.c} I_{sc}}\right) = \left(\frac{60}{25 \times 10}\right) V_1$

$= 76,1$

$Z_{eq} = \frac{V_{s.c}}{I_{s.c}} = \frac{25}{10} = 2.5\ \Omega$

$R_{eq} = Z_{eq} \cos\theta = 0.6\ \Omega$, $X_{eq} = Z_{eq} \sin\theta = 2.426\ \Omega$ } Ref to Hi

* Circuit Ref to Primary



26) نفس الفكرة ومن بلاك ال Zeq جاهزة

27), 28) نفس فكرة 29 إلى صغطها الأنبس فيها زيادة

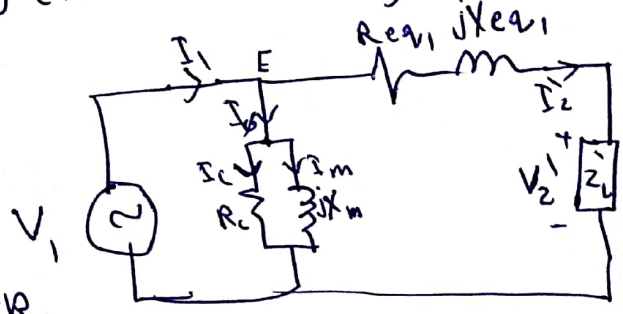
29) $S = 10KVA$, $V_1 : V_2 = 220 : 110$

$R_1 = 0.02\Omega$, $R_2 = 0.01\Omega$, $R_c = 200\Omega$

$X_1 = 0.04\Omega$, $X_2 = 0.01\Omega$, $X_m = 300\Omega$

75% of full load, Unity Power (P.F = 1)

a) referred to Primary (APProximate)



$a = \frac{N_1}{N_2} = \frac{V_1}{V_2} = 2$

$\bar{V}_2 = a V_2 = 220$

$Req_1 = R_1 + R_2' = R_1 + a^2 R_2$

$= 0.02 + 4 * 0.01 = 0.06\Omega$

$Xeq_1 = X_1 + X_2' = X_1 + a^2 X_2 = 0.04 + 4 \times 0.01 = 0.08\Omega$

$I_{2(FL)} = \frac{S}{V_2} = \frac{10K}{110} = 90,91\ A$

$\bar{I}_{2(FL)}' = \frac{I_{2(FL)}}{a} = 45,45\ A$

$\bar{I}_2' = \frac{75}{100} I_{2(FL)}' = 34,1\ A$ or $\bar{I}_2' = \frac{75}{100} * \frac{S}{V_2'} = 34,1\ A$

$\theta = \cos^{-1}(1) = 0 \longrightarrow I_2' = 34,1 \angle 0\ A$

$V_1 = E = I_2'(Req_1 + jXeq_1) + V_2' = 222,06 \angle 0.703\ V$

$I_1 = I_\phi + I_2' = I_c + I_m + I_2' = \frac{E}{R_c} + \frac{E}{jX_m} + I_2'$

$\therefore I_1 = 35,23 \angle -1,18\ A$

* b)

c) $\eta = \frac{V_2' I_2' \cos(\theta_{V_2'} - \theta_{I_2'})}{V_1 I_1 \cos(\theta_{V_1} - \theta_{I_1})} = \frac{V_2 I_2 \cos\theta_2}{V_1 I_1 \cos\theta_1} * 100 = \frac{220 * 34,1 \cos(0-0)}{222,06 * 35,23 \cos(0.703)} * 100$

$\simeq 96\ \%$

30) Like (25)

25) ref to secondary

$\because R_{cH} = 5000$, $X_{mH} = 503$

$R_{eqH} = 0.6$, $X_{eqH} = 2.43$

then

$$R_{cL} = \frac{R_{cH}}{a^2} = 5000 \div \left(\frac{500}{250}\right)^2$$

$$= 1250\,\Omega$$

same with

$X_{mL} = 125,75$

$R_{eqL} = 0.15$

$X_{eqL} = 0.607$

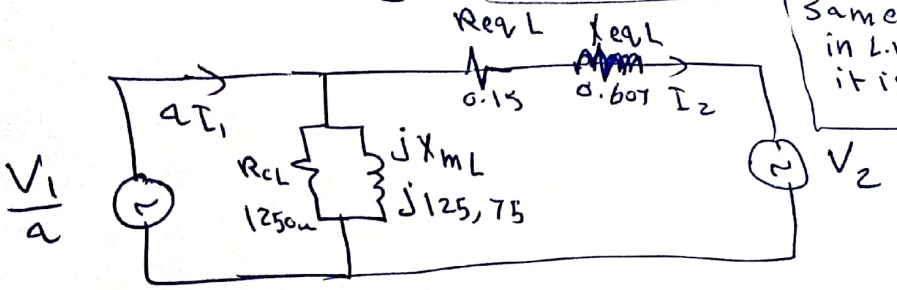
*when L.V open or short then it is refrence to Primary

when H.V open or short then it is refrence to secondary

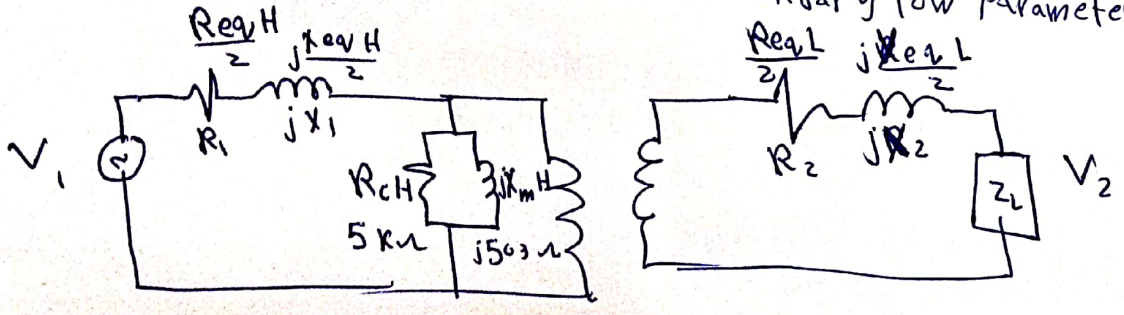
if short test in H.V then it is ref to High.

same if test in L.V then it is ref to Low

Circuit ref to secondary



*ideal Tr. circuit (Primary high parameters, secondary low parameters)



$R_1 = \frac{R_{eqH}}{2} = \frac{0.6}{2} = 0.3\Omega$, same $X_1 = \frac{2.43}{2} = 1.215\Omega$

$R_2 = \frac{R_{eqL}}{2} = \frac{0.15}{2} = 0.075\Omega$, same $X_2 = \frac{0.607}{2} = 0.3\Omega$

assume $R_1 = \overline{R_2}$, $X_1 = \overline{X_2}$